

**Program Charter
for
Tsunami**

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1. EXECUTIVE SUMMARY

Program Description

The Tsunami Program http://www.ppi.noaa.gov/weather_water/TsunamiPage.html is part of a cooperative effort to save lives and protect property through hazard assessment, warning guidance, mitigation, research capabilities, and international coordination. Hazard assessment is a process identifying tsunami sources, estimating tsunami frequency, developing models and maps of inundation, and providing input to vulnerability assessments to determine coastal risks. Warning guidance is accomplished by tsunami warning centers that acquire observational data from seismic and water-depth monitoring networks, process the data to assess the tsunami threat, and disseminate using a variety of communication systems to issue timely and accurate warning information bulletins to emergency management agencies and the public. Mitigation, advanced through collaborative initiatives such as *TsunamiReady*, is capacity building, education, and outreach using a multi-hazards approach to enhance awareness and preparedness for communities at risk. Research is the improvement toward understanding tsunami processes and impacts as well as development of more efficient and effective warning and mitigation measures. International coordination involves working with other agencies, countries, and organizations to ensure interoperability of regional tsunami warning systems with the U.S. national system and the exchange of data to increase national tsunami safety and system sustainability. NOAA's Tsunami Program is a matrixed program that resides in NOAA's Weather and Water Goal.

NOAA operates two Tsunami Warning Centers: The West Coast and Alaska Tsunami Warning Center (WC/ATWC) in Palmer, Alaska and the Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) in Ewa Beach, Hawaii. The WC/ATWC serves as the regional center for the U.S. States of Alaska, Washington, Oregon, and California and the Canadian Province of British Columbia. The WC/ATWC also has the responsibility as the regional center for the U.S. Gulf and Atlantic Coasts, as well as the Atlantic coast of Canada. The PTWC is the regional center

for the State of Hawaii, the U.S. National center for all other U.S. interests in the Pacific, the international warning center for tsunamis that pose a regional or Pacific-wide threat, and the operational center for the Pacific Tsunami Warning System (PTWS). The PTWS represents the interests of 26 Member States of the UNESCO Intergovernmental Oceanographic Commission (IOC) that are organized as the Intergovernmental Coordination Group for the Pacific Tsunami Warning System in the Pacific (ICG/PTWS) and maintains the IOC's International Tsunami Information Center (ITIC). PTWC also provides tsunami warning guidance to the ITIC, as the Secretariat, Puerto Rico, the U.S. Virgin Islands and serves as an interim warning center for the Indian Ocean and Wider Caribbean Region (WCR).

Improvement to tsunami observation networks, production of inundation maps, and coordination and technical support for forecast delivery are coordinated under the Federal-State National Tsunami Hazard Mitigation Program (NTHMP) – a partnership of NOAA with other Federal agencies having tsunami risk reduction efforts and all U.S. coastal States, territories and assets.

In 2005, the Tsunami Program began strengthening the existing U.S. tsunami warning system. This includes assisting State efforts to extend hazard assessments and inundation modeling to previously unmapped coastal regions, attaining 24-7 operation at the Tsunami Warning Centers, increasing the availability of timely and accurate seismic and water level monitoring data thorough expanded coverage and technology upgrades, enhancing existing information dissemination systems, improving forecasts and warnings, and extending education and outreach programs to ensure sustainment and capacity building.

In parallel with the domestic effort, the Tsunami Program is supporting and strengthening existing international agreements and relationships with other nations and organizations to improve the durability of regional tsunami warning and mitigation systems. For example, the U.S. Government has a strong ongoing relationship with several United Nations agencies, the World Meteorological Organization (WMO), and other intergovernmental bodies involved in tsunami and tsunami-related risk reduction. The U.S. also maintains numerous long-term science and technology agreements with other countries driving tsunami research and risk reduction efforts. In particular, NOAA's Tsunami Program works closely with the UN Educational, Scientific, and Cultural Organization's Intergovernmental Oceanographic Commission (UNESCO-IOC), providing expertise, knowledge and technology to coordinate the regional and global tsunami warning systems. The Tsunami Program is also linked with the Group on Earth Observations (GEO) since the global tsunami warning system is part of the multi-hazards warning system of the Global Earth Observing System of Systems (GEOSS).

These activities are supported by the Requirements Drivers described in Section 2.

Why the Program Exists

The Tsunami Program exists to coordinate and integrate the scientific and operational expertise, resources, and capacity across NOAA required to monitor, understand, and provide early warning of tsunami and related natural marine hazards to meet our Nation's national and international economic, social, and environmental needs. Addressing the physical and temporal scale of the "tsunami" phenomenon requires multiple functional capabilities to be harnessed efficiently and effectively including real-time ocean and coastal observation, tsunami forecast models that optimally interpret these observations, hazard and economic assessment and prediction, data management and communications, and outreach and education.

The phenomenon called "tsunami" is a series of traveling ocean waves of extremely long lengths generated by displacements of the sea associated primarily with earthquakes occurring below or near the ocean floor. Underwater eruptions, landslides, and meteor impacts can also generate tsunamis. In the deep ocean, the length of a tsunami wave from wave crest to wave crest may be 100 miles or more with a wave height of only a few inches or less. They cannot be felt aboard ships nor can they be seen from the air in the open ocean. In deep water, tsunami waves may propagate at speeds exceeding 500 miles per hour. As tsunami waves near shore, the run up is characterized by decreasing water depths that slow the wave, increasing its amplitude at the same time that succeeding waves catch up. The result can be a series of devastatingly large waves at the shoreline.

Tsunamis are a threat to the lives and property of anyone living near the ocean. The Indian Ocean Tsunami that occurred on December 26, 2004 demonstrated this threat with frightening clarity. With nearly 300,000 lives lost, affected nations and the worldwide community recognized the need for a tsunami warning capability similar to the one operated by NOAA for the U.S. West Coast and the Pacific Ocean Nations.

Subduction zones similar to the one off of the coast of Indonesia that caused the December 26, 2004 tsunami exist off the coasts of the Pacific Northwest states, Alaska, and the U.S. Territories of Puerto Rico and the U.S. Virgin Islands. A similar tsunami from an earthquake in either the Juan de Fuca Plate or the Puerto Rico trench could have catastrophic effects on heavily populated U.S. cities. Fifty percent of the US population lives on or near the coast. A significant tsunami arriving anywhere along the US coast is likely to threaten life, property, and infrastructure—and disrupt local and regional economies. Tsunamis also impact the natural environment and the many services coastal resources provide—from nurseries for commercial fisheries to the primary attraction for vacation and resort economies. Popular vacation spots such as The Outer Banks, North Carolina and Caribbean Nations would also be impacted resulting in significant loss of life and severe impact on their economies and natural environments.

Recognizing the significant threat of tsunamis and related tsunami-hazards, the U.S. Government sustains and expands hazard assessment, warning guidance, mitigation, and research capabilities. The U.S. also has a growing interest in and links with the global tsunami warning and mitigation system that -- through effective international cooperation regional warning system support and augmented U.S. tsunami warning capabilities-- provides critical scientific data and understanding about tsunamis, reduces costly risks and increases national safety.

More Tsunami information can be found at:

http://www.ppi.noaa.gov/weather_water/TsunamiPage.html

2. Program Requirements

A. Requirement Drivers:

1. **Legislative Mandates** directing NOAA to invest in development and operation of warning systems include:

- ***National Weather Service Organic Act, 15 U.S.C. § 313.*** - Sets forth the primary duties of the National Weather Service, including the requirements that the Secretary of Commerce shall: forecast the weather; issue storm warnings; display weather and flood signals for the benefit of agriculture, commerce, and navigation; gauge and report the flow of rivers; maintain and operate the seacoast telegraph lines and collect and transmit marine intelligence for the benefit of commerce and navigation; report temperature and rain-fall conditions for the cotton interests; display of frost and cold-wave signals; distribute meteorological information in the interests of agriculture and commerce; and take the meteorological observations that may be necessary to establish and record the climatic conditions of the United States, or that are essential for the proper execution of the foregoing duties. And the nature of the duties “to develop adequate warning system for the severe hazards of nature – hurricanes, tornadoes, floods, earthquakes and seismic sea waves” indicates that these tsunami (*seismic sea wave*) warning activities are more than discretionary.
- ***Coast and Geodetic Act, 33 U.S.C. §§ 883a - 883i.*** - This Act provides the basis for NOS navigation service programs as well as OAR and NWS coastal seismic and sea level monitoring duties, including the Pacific Tsunami Warning Center (PTWC), and related data management responsibilities of NESDIS. Sec. 883a authorizes the Secretary of Commerce to conduct hydrographic and topographic surveys, tide and current observations, geodetic-control surveys, field surveys for aeronautical charts, and geomagnetic, seismological,

gravity, and related geophysical measurements to provide charts and other information for safe

marine and air navigation. This information is collected, analyzed, assimilated, and distributed by DOC. The National Ocean Survey [NOAA] is designated as the central depository for geomagnetic data, and the Secretary is authorized to collect, correlate and disseminate such data. The Act authorizes the Secretary to conduct developmental work for the improvement of surveying and cartographic methods and instruments and to conduct investigations and research in geophysical sciences. The Secretary is authorized to enter into cooperative agreements with states, federal agencies, public or private organizations or individuals, for surveying, mapping and publication activities, and to contract with qualified organizations for National Geodetic Survey functions. The Act provides for a permanent authorization of appropriations.

Note further, that specific duties of the Coast and Geodetic Survey included operation of the National Geomagnetism Program and Honolulu Geomagnetic Observatory (established 1902) and the U.S. Seismic Sea Wave Warning system established at the Honolulu Observatory (established in 1946). In 1949 the Pacific Tsunami Warning Center (PTWC) in Ewa Beach, Hawaii was established to provide warnings from teletsunamis to most countries in the Pacific Basin as well as to Hawaii and all other US interests in the Pacific outside of Alaska and the U.S. West Coast.

The language in the Act is generally permissive: The Secretary is “authorized” to do various functions. But the statute, passed in 1947, stated as its purpose “To define the functions *and duties* of the Coast and Geodetic Survey, and for other purposes.” And the nature of the functions and duties (examples include mapping of coastal areas; observance, analysis and prediction of tide and current data; serving as a central depository of the U.S. Government for geomagnetic data) indicates these activities are more than discretionary.

By Department Organization Order 25-5A (now found in DOO 10-15), the Secretary designated his functions under this authority to the NOAA Administrator.

2. International or inter-agency cooperation developed bilateral or multilateral requirements documents (**e.g. Memorandum of Understanding and Supporting Agreements**) as applicable.

- *IOC Resolution IV-6, November 1965 for the Establishment of the International Coordination Group for the Tsunami Warning System in the Pacific* (TWSP or Intergovernmental Coordination Group known as ICG/ITSU) for the purpose to provide or improve all aspects of tsunami warning and mitigation in the Pacific including hazard assessment, warnings, preparedness and research through a system of international cooperation and coordination activities:
- Resulting in the PTWC in Hawaii becoming the operational center for the TWSP, the ITIC hosted by U.S. for ICG/ITSU, with current area of responsibility for tsunami warning guidance extending to some Central American countries, Puerto Rico and the US Virgin Islands

- Acknowledging that PTWC in 2005 is providing interim information bulletins for the Indian Ocean and the Wider Caribbean Region.

Reorg. Plan No. 2 of 1965, 3 C.F.R. xxx (1965), reprinted in 5 U.S.C. app. at 1517 (1994), and in 79 Stat. 1318-20 (1965), and in 30 Fed. Reg. 8819-xx (1965)] included support for the Palmer Observatory, originally under the Coast and Geodetic Survey, for timely and effective tsunami and earthquake information, establishing the Alaska Regional Tsunami Warning System (ARTWS) in 1967.

- Noting transfer to the National Weather Service's Alaska Region in 1973, in 1982 the area of responsibility for the WC/ATWC was expanded to include tsunamis in the coastal areas of California, Oregon, Washington, Alaska, and British Columbia, and in 1996 to include all Pacific-wide tsunamigenic sources;
- Acknowledging that in 2005 the WC/ATWC area of responsibility expanded to include the U.S. Atlantic and Gulf of Mexico coasts and the Atlantic Provinces of Canada.
- *Compact of Free Association Amendments Act of 2003, Pub. Law No. 108-188, 117 Stat. 2720 (2003).*: authorizing NOAA to provide forecast and warning support, including tsunami warnings, to The Republic of the Marshall Islands, The Federated States of Micronesia, and The Republic of Palau.
- *Tsunami Hazard Mitigation Implementation Plan, A Report to the Senate Appropriations Committee (April 1996)*, cites on page 1 the "Report on FY95 Budget (July 1994)" and "Report on FY96 Budget (July 1995)" as authority. Congressional action for the Federal/State National Tsunami Hazard Mitigation Program (NTHMP) to provide improved tsunami hazard assessments, a backbone network of local seismic stations, and tsunami wave and water level observations, preparedness, modeling and mapping, forecasts and warnings.
- *Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005*, Pub. L. No. 109-13, 119 Stat. 231 (May 11, 2005) at Div. A, Title IV, 119 Stat. 273. expands national tsunami detection and monitoring capabilities, thus improving tsunami protection for the United States and the world - increased NOAA and USGS appropriations – authorizes NOAA to add 32 DART stations to its current network, develop forecast models to interpret the DART data, assist the States in developing coastal inundation maps, provide community outreach and preparedness programs, upgrade the PTWC, and increase personnel at U.S. Tsunami Warning Centers for 24-7 operation.

3. Direction and Guidance

- President's National Science and Technology Council's Tsunami Risk Reduction for the United States: A Framework for Action (issued December 2005) calls for the expansion of NOAA's NTHMP to serve a total of 28 coastal states, commonwealths, and territories and deliver the expected benefit of more disaster-resilient communities. Includes direction not limited to but including: performing National Tsunami Risk and Hazard Assessments; develop a National Response Plan; new and improved warnings and forecast products; and

improved tsunami preparedness at the state and local level. U.S. Commission on Ocean Policy (September 2004) called for a plan to transfer all the information collected by these federal agencies into one Integrated Ocean Observing System (IOOS), with NOAA serving as the lead agency.

- U.S. Ocean Action Plan (AOP), Executive Order (signed December 2004) in response to the U.S. Commission on Ocean Policy, calls for, among other things, development and implementation of common principles and goals for the conduct of governmental activities on ocean-related matters; use of science in establishment of policy on ocean-related matters; and collection, development, dissemination, and exchange of information on ocean-related matters; and ensure coordinated government development and implementation of the Integrated Ocean Observing System (IOOS) that will be a major element of the Global Ocean Observing System (GOOS), the ocean component of the Global Earth Observation System of Systems (GEOSS).
- NOAA National Weather Service, approved Tsunami Program Roadmap (FY2001-2007) Goals and NWS Directives: “(1) ensure timely and reliable tsunami warnings; (2) develop methods to forecast tsunami wave heights; (3) increase warning center continuity of operations; (4) improve message dissemination methods and products; (5) support international tsunami warning program; and (6) expand U.S. tsunami program to the Caribbean.”
- Memorandum of Understanding (2004) between U.S. Geological Survey (USGS) and NOAA as a framework for cooperation and coordination, and explicitly including natural disaster risk reduction “such as erosion, earthquakes, landslides, tsunamis, flooding and volcanoes...”
- U.S. Administration’s National Disaster Reduction Initiative (NDRI) 1999, consistent with FEMA’s National Mitigation Strategy and the Committee on Environmental Natural Resources Natural Disaster Reduction plan for the Nation, supports an interagency effort (including NOAA) to save lives, reduce and mitigate the direct and indirect costs and risks of natural disasters.
- Interagency Agreement between USAID and NOAA (2005) to assist in the development of a Tsunami Warning capability in the Indian Ocean Basin. This effort includes deployment of buoys, forecasting and warning infrastructure, and education.
- IOC Resolution XXIII-13, June 2005 for Establishment of an Intergovernmental Coordination Group for Tsunami and Other Coastal Hazards Warning System for the
- Caribbean and Adjacent Regions, IOC Resolutions XX-14, July 1999, EC-XXXV.1, EC-XXXV.5 (recommendation SC-IOCARIBE-VII.2) June 2002, and EC-XXXVII.7, approving and supporting the establishment of a Tsunami Warning System for the Caribbean and Adjacent Regions and IOCARIBE-GOOS,

- IOC Resolution XXIII-14, June 2005 for establishing Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS).
- IOC Resolution XXIII-15 June 2005 for Establishment of a Framework for the Global Tsunami and Other Ocean-related Hazards Early Warning System.
- Resolution XXII-6 approved the IOC Oceanographic Data Exchange Policy, which states that the timely, free and unrestricted international exchange of oceanographic data is essential, among others, for the preservation of life.
- Communiqué of the IOCARIBE International Conference for the Establishment of a Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions, adopted in Mexico City, Mexico June 3, 2005;
- Mauritius International Meeting on Small Island Developing States held at Port Louis from 10 to 14 January 2005, and the Mauritius Strategy for the further implementation of the Barbados Programme of Action for the Sustainable Development of Small Island States, adopted in Port Louis January 14, 2005.
- UN General Assembly Resolution 59/279 adopted in New York on January 19, 2005;
- Hyogo Framework for Action 2005-2015 adopted at the World Conference on Disaster Reduction, adopted in Kobe, Japan on 22 January 2005;
- Communiqué of the 3rd Earth Observation Summit (GEO) adopted in Brussels, Belgium, February 16, 2005, which supports "the coordinating activities of the UNESCO Intergovernmental Oceanographic Commission (IOC) and related national and regional initiatives to realize effective tsunami warning systems in the Indian Ocean and other regions of the world, as an integral part of a multi-hazard approach supported by GEOSS (Global Earth Observation System of Systems)",
- Communiqué of the IOC International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean within a Global Framework, adopted in Paris France on March 8, 2005;
- Direction and guidance provided by Mauritius Declaration of the Second International Coordination Meeting of the Development of an Indian Ocean Tsunami Warning and Mitigation System (adopted in Grand Baie, Mauritius, April 16, 2005);
- Communiqué of the International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean (adopted March 8, Paris 2005)

B. Mission Requirements:

- Develop **tsunami hazard assessment** for all at risk coastal regions of the U.S. and its territories by improving models and predictability of the onset, duration, and impact of a

tsunami event as outlined in the National Weather Service Organic Act, U.S. Congressional actions to establish in 1949 the Pacific Tsunami Warning Center (PTWC), Title 33 C17 United States Code 883d, etc.

- Enhance **tsunami warning guidance** by issuing accurate, timely, reliable, and effective forecast and warnings along U.S. coastlines (Pacific, Atlantic, Caribbean, and Gulf) and ensure an effective tsunami observation network (providing comprehensive coverage and supplying real-time data into forecast models), in coordination with the Global Tsunami Warning System of IOC and contributing to the multi-hazards warning system of the Global Earth Observation system of Systems (GEOSS), the international effort to develop a comprehensive, sustained, and integrated Earth observation system as outlined in the National Weather Service Organic Act.
- Develop **mitigation** measures for tsunami and tsunami related risks by providing tsunami community outreach programs to increase public and emergency manager preparedness (includes NTHMP, coastal state tsunami planning, encouraging the use of appropriate land use measures, promoting policies that reduce exposure to coastal hazards as outlined in the National Weather Service Organic Act.
- Advance **research** science and technology development to improve the predictability of the onset, duration, and impact of a tsunami event through science and technology developments (e.g., improve seismic and tsunami wave observations and develop and implement methodologies and procedures enhancing timeliness, accuracy, reliability, and effectiveness of forecasts and warnings to ensure preparedness and resilience) as outlined in the National Weather Service Organic Act.
- Encourage **international coordination** by encouraging interoperability and data exchange between U.S. national system and other regional tsunami warning systems, such as IOCARIBE; provide technical expertise, knowledge and technology, as appropriate, to sustain and improve regional and global tsunami and multi-hazard warning systems as outlined in the National Weather Service Organic Act.

III. LINKS TO THE NOAA STRATEGIC PLAN

A. Goal Outcomes: NOAA's Tsunami Program Contributes to the following Weather and Water (W&W) Goal Outcomes from the NOAA Strategic Plan:

- Through its capability to detect tsunamis and generate and disseminate Tsunami warnings, the Tsunami Program supports reduced loss of life, injury, and damage to the economy.
- By expanding the U.S. Tsunami Network, increasing public and emergency manager knowledge of tsunamis through programs such as *TsunamiReady*, and performing research and development activities to improve tsunami detection stations (DART-2) NOAA's Tsunami Program directly supports better, quicker, and more valuable weather and water information to support improved decisions.

- Through its capabilities to improve tsunami detection technology, forecast tools, and education and outreach NOAA's Tsunami Program supports increased customer satisfaction with weather and water information and services.

B. Goal Performance Objectives: NOAA's Tsunami Program contributes to W&W's attainment of the following W&W Mission Goal Objectives:

- Increased lead times and accuracy of W&W warnings and forecasts through investments in tsunami detection infrastructure (DART Stations and NWLON) and continued research and development.
- Investments in tsunami detection infrastructure (DART Stations and NWLON) and continued research and development will result in increased lead times and accuracy of W&W warnings and forecasts.
- Improved predictability of the onset, duration, and impact of hazardous and severe W&W events through the Tsunami Program's Research and Development capacity.
- The Tsunami Program's Research and Development capacity supports improved predictability of the onset, duration, and impact of hazardous and severe W&W events.
- Increased development, application, and transition of advanced science and technology to operations and services through the Tsunami Program's Research and Development and Operational capacities.
- The Tsunami Program's Research and Development and Operational capacities support increased development, application, and transition of advanced science and technology to operations and services.
- Increased development, application, and transition of advanced science and technology to operations and services through the Tsunami Programs Education and Outreach, International Tsunami partnerships, and GEOSS support.
- The Tsunami Programs Education and Outreach, International Tsunami partnerships, and GEOSS support increased coordination of W&W information and services with integration of local, regional, and global observation systems.
- Reduced uncertainty associated with W&W decision tools and assessments through the Tsunami Program's Education and Outreach capability
- The Tsunami Program's Education and Outreach capability supports reduced uncertainty associated with W&W decision tools and assessments.
- Enhanced environmental literacy and improved understanding, value, and use of W&W information and services the Tsunami Program's Education and Outreach capability.

- The Tsunami Program's Education and Outreach capability supports enhanced environmental literacy and improved understanding, value, and use of W&W information and services.

C. Goal Strategies: NOAA's Tsunami Program contributes to W&W's attainment of the following W&W Mission Goal Strategies by:

- Improving the reliability, lead-time and effectiveness of weather and water information and services that predict environmental changes.
- Developing and infusing research results and new technologies more efficiently to improve products and service, streamline dissemination, and communicate vital information more effectively.
- Working with private industry, universities, and national and international agencies to create and leverage partnerships that foster more effective information services.
- Building a broad-based and coordinated education and outreach program by engaging individuals in continuous learning toward a greater understanding of the impacts of weather and water on their lives.
- Employing scientific and emerging technological capabilities to advanced decision support services and educate stakeholders.
- (Ecosystem) Engaging in technological and scientific exchange with our domestic and international partners to protect, restore, and manage marine resources within and beyond the nation's borders.

IV. PROGRAM OUTCOME(S)

- Reduce loss of life, injury, and damage to the economy through improved tsunami detection, and detailed forecast and warning information to emergency and coastal zone managers.
- Reduce loss of life, injury, and damage to the economy by increasing tsunami awareness and knowledge for persons in tsunami vulnerable areas.
- Reduce the loss of human lives and property through improved tsunami detection, forecast and warning, and hazard mitigation activities.
- Increase the number of persons educated about tsunami preparedness.
- Provide emergency managers with enough detail to appropriately scale their tsunami mitigation activities (evacuations are based on tsunami size, run-up maps, etc.).

V. PROGRAM ROLES AND RESPONSIBILITIES

This program is established and managed with the procedures established in the NOAA Business Operations Manual (BOM). Responsibilities of the Program Manager are described in the BOM. Responsibilities of other major participants are summarized below.

A. Participating Line Office, Staff Office, and Council Responsibilities

1) NOAA's National Weather Service (NWS) is responsible for the overall execution of the Tsunami Program. This includes operation of the U.S. Tsunami Warning Centers as well as leadership of the National Tsunami Hazard Mitigation Program. It also includes the acquisition, operations and maintenance of observation systems required in support of tsunami warning such as DART, local seismic networks, coastal, and coastal flooding detectors. NWS also supports observations and data management through the National Data Buoy Center (NDBC) and mitigation through its *TsunamiReady* Program, outreach to partners, and dissemination of the Tsunami Program's products.

2) NOAA's Ocean Service (NOS) is responsible for deploying, upgrading, and maintaining the multi-mission NWLON stations that detect tsunamis and provide real-time data that assist in preparing tsunami warnings, and dealing with the issues of tidal datum conversions to orthometric datums using V-DATUM tool for different regions of the U.S. In addition, NOS performs risk and vulnerability assessments and works with communities to mitigate multiple natural hazards, including tsunamis. NOS encourages States and Regions to adopt appropriate hazard mitigation measures, including guiding development away from risk areas. NOS is also responsible for mobilizing the assets of the Emergency Response Program to prepare and respond to tsunamis, NOS provides financial support to coastal states' for tsunami planning and preparedness activities. NOS also provides bathymetric, shoreline, and topographic datasets used in the development of tsunami forecast models.

3) NOAA's Office of Oceanic and Atmospheric Research (OAR), and in particular the Pacific Marine Environmental Laboratory (PMEL), conducts research and development for tsunami detection, sensor platforms, communication networks, improved understanding of tsunami generation mechanisms, tsunami forecasts, inundation models and maps, and related activities leading to breakthrough performance in accuracy, timeliness, reliability and effectiveness of tsunami warnings and mitigation efforts.

4) NOAA's Marine and Aviation Operations (NMAO) aids fleet allocation, and vessel acquisition and deployment, in coordination with the NWS National Data Buoy Center management of the Tsunami Program's platform resources (including DART stations), and to meet operations, maintenance, and research requirements.

5) NOAA's National Environmental Satellite and Information Service (NESDIS) -provides data archive capability through its National Geophysical Data Center (NGDC). It also provides satellite capabilities necessary for remote collection of sea level data in near real time and for

dissemination of warnings through systems such as EMWIN and RANET.

6) NOAA's Weather and Water Goal's Environmental Modeling, Local Forecast and Warnings, and Coasts, Estuaries and Oceans, and Science, Technology and Infusion Programs contribute to NOAA's Tsunami Program through their respective modeling, detection and warning, operations and maintenance, research capacities.

7) NOAA's Commerce and Transportation Goal, Marine Transportation Systems Program provides related near-shore observations and services.

8) NOAA's Mission Support Sub-Goal's Fleet, Facilities, Information Technology Services Programs provide critical infrastructure to NOAA's Tsunami Program.

9) NOAA's Councils (Education, Observing System, Chief Information Officer, International Affairs, Ocean, Fleet, and Research) are responsible for providing policy guidance and frameworks within which the Tsunami Program can operate to resolve issues in education and outreach, observations, modeling, international activities, and tool development.

10) The NOAA Office of General Counsel (GC) is responsible for providing legal services necessary to enable the program to discharge its duties. In this regard, NOAA GC provides a variety of specific services on an as-needed basis, including but not limited to: advice on legal issues related to program responsibilities; review and clearance of agreements, testimony, correspondence, and other documents; legal representation; assistance with litigation and requests for testimony or information; and coordination on behalf of the program with the Department of Commerce GC in the areas of contract, grant, intellectual property, labor and employment, appropriations, legislation and regulation, grant, litigation, and telecommunications law.

C. External Agency/Organization Responsibilities

1) United States Geological Survey (USGS) – Provides much of the key seismic data in support of warning operations. Collaborates with NOAA's research groups by developing specifications of potential seismic, landslide and other tsunami sources suitable for forecast models, including the probability of occurrence, when possible, and providing bathymetry, coastlines and topography for numerical modeling and other purposes. Assists NOAA with upgrades of its own local seismic networks for tsunami warning. Partners with NOAA for its *TsunamiReady* Program

2) Federal Emergency Management Agency (FEMA) – Provides federal aid and assistance to those who have been affected by all types of disaster. Partners with NOAA for promoting tsunami preparedness. Provides emergency managers with assistance in hazard mitigation and response planning. Collaborates in development of NOAA/FEMA training courses for emergency managers.

3) United States Coast Guard (USCG) - Assists NOAA with the deployment and maintenance of DART Stations (utilized to supplement NOAA's Fleet Services)

- 4) U.S. Agency for International Development (USAID) – U.S. Government's lead agency to manage and coordinate a multi-agency effort involving NOAA, USGS, US Trade and Development Agency (USTDA), the U.S. Forest Service and the State Department to develop an integrated, end-to-end Indian Ocean Tsunami Warning System (IOTWS), within a multi-hazard disaster management framework.
- 5) Department of Homeland Security – NOAA provides daily information on extreme weather and water events to their operations center to support homeland security. DHS partners with NOAA on Homeland Security preparedness activities. NOAA is also a major contributor to the National Response Plan coordinating the work of 27 agencies during and after disasters.
- 6) Los Alamos National Laboratory - Has provided useful research on tsunamis based on their numerical tsunami models and access to supercomputer facilities.
- 7) Department of Defense (DoD) – relies on NOAA's Tsunami Program for calibrating models and for data relating to military operations.
- 8) Department of State – provides NOAA assistance with its International Activities.
- 9) National Tsunami Hazard Mitigation Program (NTHMP) – Congressionally mandated program that coordinates the efforts of Federal and State/Territory/Commonwealth programs involved with tsunami warning guidance, hazard assessment and mitigation.
- 10) National Disaster Education Coalition (NDEC) – promotes consistent science and safety messages for all environmental and technological hazards through jointly published safety publications. The Coalition started with NOAA, the American Red Cross, and FEMA. It has expanded with the addition of the following: National Fire Protection Association; U.S. Geological Survey; Institute for Business and Home Safety; Home Safety Council; National Cable and Telecommunications Association; Food and Drug Administration Center for Food Safety and Applied Nutrition; U.S. Fire Administration; Centers for Disease Control and Prevention; Consumer Product Safety Commission; International Association of Emergency Managers; the U.S. Department of Agriculture Cooperative State Research, Education, and Extension Service; and a representative from the National Science Foundation.
- 11) International Association of Emergency Managers (IAEM) - provides feedback to NOAA on proposed products and services. IAEM has a representative on the NOAA National *StormReady* Advisory Board to suggest program improvements from the local emergency management perspective. IAEM promotes collaboration between local and county level emergency managers and NOAA.
- 12) National Emergency Management Association (NEMA) - provides feedback on proposed products and services. NEMA has a representative on the NOAA's National *StormReady* Advisory Board to suggest program improvements from the state level emergency management perspective. NEMA promotes collaboration between state emergency management and NOAA.
- 13) State and Local Emergency and Coastal Managers – partner with NOAA in the warning

process by disseminating NOAA warnings and directing appropriate response actions, such as evacuations. They also assist in preparedness activities and in refining existing and defining future NOAA services.

14) State Homeland Security Offices -

15) Tsunami Warning System in the Pacific (TWSP) – Organized in 1965 by the UNESCO Intergovernmental Oceanographic Commission to provide warnings for regional and Pacific-wide tsunamis and to facilitate cooperation and coordination of tsunami preparedness, mitigation, warning, and research activities among its current 26 Member States.

16) International Tsunami Information Center (ITIC) – UNESCO’s Intergovernmental Oceanographic Commission ITIC monitors the operations of the Tsunami Warning System in the Pacific and promotes tsunami awareness and education.

17) Intergovernmental Oceanographic Commission (IOC) – Part of the United Nations Educational, Scientific and Cultural Organization (UNESCO). Has the lead role in coordinating UN agency activities for development of tsunami warning systems in the world’s oceans and seas. NOAA is a partner with IOC in its activities and the U.S. representative to the IOC is from NOAA.

18) Global sea-Level Observing System (GLOSS) under the auspices of the Joint Commission of Oceanography and Marine Meteorology (JCOMM) of the WMO and the IOC, establishes global and regional networks of multi-purpose sea level monitoring stations including many real-time tsunami stations.

19) World Meteorological Organization (WMO) monitors, detects and develops early warnings for natural hazards related to weather, climate and water. WMO supports the Telecommunications Gateway infrastructure required for efficient and reliable dissemination of tsunami-relevant data and information. WMO is working together with UNESCO-IOC, International Strategy for Disaster Reduction (ISDR) and other key partners at the international, regional, and national levels to contribute its relevant capabilities to the development of end-to-end tsunami early warning systems in the Indian Ocean and other regions at risk. WMO is also committed to developing the capabilities of the National Meteorological and Hydrological Services (NMHSs) of the Indian Ocean Rim countries to establish an effective tsunami early warning system within a multi-hazard framework, particularly related to national multi-hazards alert and response mechanisms.

20) Joint Institute for the Study of the Atmosphere and Ocean (JISAO) University of Washington, Seattle– is engaged in tsunami forecast modeling and the research and development required to improve such models.

21) Joint Institute for Marine and Atmospheric Research (JIMAR), University of Hawaii, Honolulu is engaged in tsunami-related research.

22) University of Hawaii Sea Level Center (UHSLC) collects, processes, distributes, and